

# Development of a Wide-Spectrum Organic Analysis Instrument

Completed Technology Project (2010 - 2013)



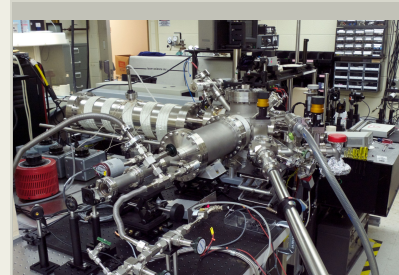
## Project Introduction

Modifying a two-step laser mass spectrometer (ultra-L2MS) to enable in situ micrometer-scale analysis of diverse organic molecules with sub-femtomole sensitivity. With previous IRD support we designed and constructed a vacuum ultraviolet (VUV) laser source, which enables efficient, soft, single-photon ionization of organic molecules. We incorporated this VUV ion source with our instrument and have successfully measured hundreds of organic molecules on test samples. The modified instrument is unique and enables the measurement of organic molecules with an unprecedented combination of sensitivity and spatial resolution.

In FY'13 we expanded our analysis of samples to include astromaterials and biological materials relevant to international space station (ISS) and human space flight (HSF). We are also in the process of integrating our existing UV laser photoionization source with the new VUV source to enable both to be operated simultaneously. By combining VUV photons with UV/Visible photons we can explore the use of novel two-photon (118.2 nm + 1064/532/355/266 nm) resonant and non-resonant ionization schemes. By timing the photons from both sources to arrive simultaneously in the ionization region of the ultra-L2MS instrument we can further the expanding of the range of detectable molecular species. Additionally by allowing a controlled delay between the arrival of photons from the two sources (time-delayed two-photon ionization) it may also be possible to provide structural information for certain molecular species that could not be provided by conventional mass spectrometry techniques.

## Anticipated Benefits

Improvements in microscopic organic analysis enhance the science value of planetary science missions, including the Discovery sample return missions Stardust (comet coma) and Genesis (solar wind) and the New Frontiers 3 mission OSIRIS-REx (asteroid regolith). The NASA Technology Area Roadmap ties improvements in trace organic analysis to New Frontiers 4 mission that is likely to either be a lunar or comet nucleus sample return mission, based on the National Science Foundation Decadal Survey. Trace and microscopic organic analyses will also be essential for future Mars sample return.



Project Image Development of a Wide-Spectrum Organic Analysis Instrument

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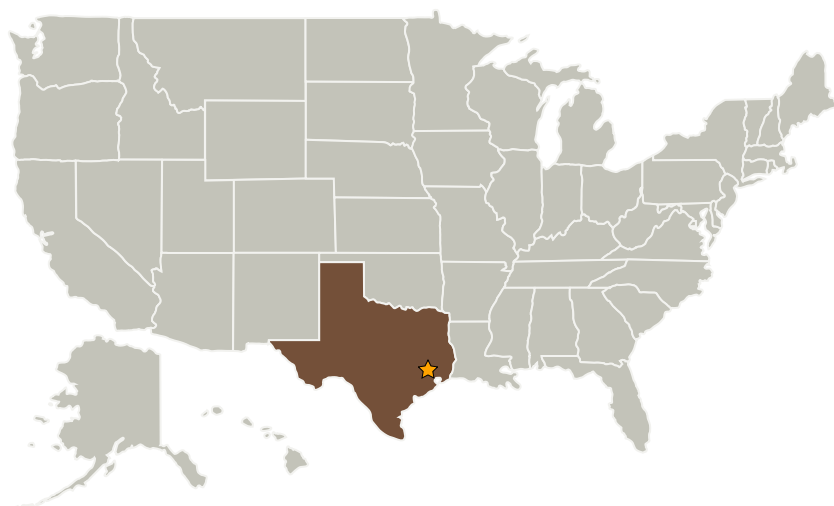
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
KBRwyle, Inc.	Supporting Organization	Industry	Houston, Texas

## Primary U.S. Work Locations

Texas

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Center / Facility:**

Johnson Space Center (JSC)

**Responsible Program:**

Center Innovation Fund: JSC CIF

## Project Management

**Program Director:**

Michael R Lapointe

**Program Manager:**

Carlos H Westhelle

**Project Manager:**

Scott R Messenger

**Principal Investigator:**

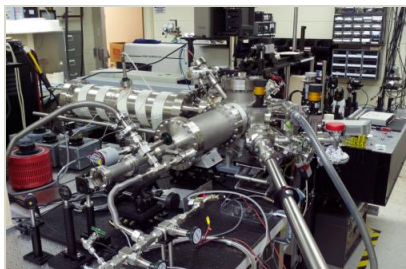
Scott R Messenger

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## Images



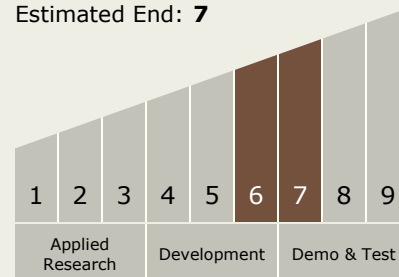
**12114-1376518388844.jpg**

Project Image Development of a Wide-Spectrum Organic Analysis Instrument

(<https://techport.nasa.gov/image/2217>)

## Technology Maturity (TRL)

Current: **6**  
Estimated End: **7**



## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.3 In-Situ Instruments and Sensors
    - └ TX08.3.2 Atomic and Molecular Species Assessment